

WHAT IS CLAIMED IS :

1. A method for the blind identification of sources within a system comprising P sources and N receivers, wherein the method comprises at least one step for the identification of the matrix of the direction vectors of the sources from the information proper to the direction vectors \mathbf{a}_p of the sources contained redundantly in the $m=2q$ order circular statistics of the vector of the observations received by the N receivers.

2. A method according to claim 1, wherein $m = 2q$ order circular statistics are expressed according to a full-rank diagonal matrix of the autocumulants of the sources and a matrix representing the juxtaposition of the direction vectors of the sources as follows:

$$\mathbf{C}_{m,x} = \mathbf{A}_q \boldsymbol{\zeta}_{m,s} \mathbf{A}_q^H \quad (11)$$

where $\boldsymbol{\zeta}_{m,s} = \text{diag}([C_{1,1,\dots,1,s}^{1,1,\dots,1}, \dots, C_{p,p,\dots,p,s}^{p,p,\dots,p}])$ is the full-rank diagonal matrix of the $m = 2q$ order autocumulants $C_{p,p,\dots,p,s}^{p,p,\dots,p}$ des sources, sized $(P \times P)$, and where $\mathbf{A}_q = [a_1^{\otimes(q-1)} \otimes a_1^* \dots a_p^{\otimes(q-1)} \otimes a_p^*]$, sized $(N^q \times P)$ and assumed to be of full rank, represents the juxtaposition of the P column vectors $[a_p^{\otimes(q-1)} \otimes a_p^*]$.

3. A method according to one of the claims 1 and 2, comprising at least the following steps:

0: the building, from the different observation vectors $\mathbf{x}(t)$, of an estimate $\hat{\mathbf{C}}_{m,x}$ of the matrix of statistics $\mathbf{C}_{m,x}$ of the observations,

1: the singular value decomposition of the matrix $\hat{\mathbf{C}}_{m,x}$, the deducing therefrom of an estimate \hat{P}_s of the number of sources P and a square root $\hat{\mathbf{C}}_{m,x}^{1/2}$ of $\hat{\mathbf{C}}_{m,x}$, for example in taking $\hat{\mathbf{C}}_{m,x}^{1/2} = \mathbf{E}_s |\mathbf{L}_s|^{1/2}$ where $|\cdot|$ designates the absolute value operator, where \mathbf{L}_s and \mathbf{E}_s are respectively the diagonal

- matrix of the \hat{P} greatest real eigenvalues (in terms of absolute value) of $\hat{\mathbf{C}}_{m,x}$ and the matrix of the associated orthonormal eigenvectors;
- 2: the extraction, from the matrix $\hat{\mathbf{C}}_{m,x}^{1/2} = [\Gamma_1^T, \dots, \Gamma_N^T]^T$, of the N matrix blocks Γ_n : each block Γ_n sized $(N^{(q-1)} \times P)$ being constituted by the $N^{(q-1)}$ successive rows of $\hat{\mathbf{C}}_{m,x}^{1/2}$ starting from the " $N^{(q-1)}(n-1)+1$ "th row;
- 3: the building of the $N(N-1)$ matrices $\Theta_{n1,n2}$ defined, for all $1 \leq n_1 \neq n_2 \leq N$, by $\Theta_{n1,n2} = \Gamma_{n1} \# \Gamma_{n2}$ where $\#$ designates the pseudo-inversion operator;
- 4: the determining of the matrix \mathbf{V}_{sol} , resolving the problem of the joint diagonalization of the $N(N-1)$ matrices $\Theta_{n1,n2}$;
- 5 5: for each of the P columns \mathbf{b}_p of $\hat{\mathbf{A}}_q$, the extraction of the $K = N^{(q-2)}$ vectors $\mathbf{b}_p(k)$ stacked beneath one another in the vector $\mathbf{b}_p = [\mathbf{b}_p(1)^T, \mathbf{b}_p(2)^T, \dots, \mathbf{b}_p(K)^T]^T$;
- 6: the conversion of said column vectors $\mathbf{b}_p(k)$ sized $(N^2 \times 1)$ into a matrix $\mathbf{B}_p(k)$ sized $(N \times N)$;
- 15 7: the joint singular value decomposition or joint diagonalization of the $K = N^{(q-2)}$ matrices $\mathbf{B}_p(k)$ in retaining therefrom, as an estimate of the column vectors of \mathbf{A} , of the eigenvector common to the K matrices $\mathbf{B}_p(k)$ associated with the highest eigenvalue (in terms of modulus);
- 8: the repetition of the steps 5 to 7 for each of the P columns of $\hat{\mathbf{A}}_q$ for the estimation, without any particular order and plus or minus a phase, of the P direction vectors \mathbf{a}_p and therefore the estimation, plus or minus a unitary trivial matrix, of the mixture matrix \mathbf{A} .
- 20 4. A method according to one of the claims 1 to 3 wherein the number of sensors N is greater than or equal to the number of sources P and wherein the method comprises a step of extraction of the sources, consisting of the

application to the observations $\mathbf{x}(t)$ of a filter built by means of the estimate $\hat{\mathbf{A}}$ of \mathbf{A} .

5 5. A method according to one of the claims 2 to 4 wherein $\mathbf{C}_{m,x}$ is equal to the matrix of quadricovariance \mathbf{Q}_x and wherein $m = 4$.

6. A method according to one of the claims 2 to 4 wherein $\mathbf{C}_{m,x}$ is equal to the matrix of hexacovariance \mathbf{H}_x and wherein $m = 6$.

10 7. A method according to one of the claims 1 to 6 comprising a step for the evaluation of the quality of the identification of the associated direction vector in using a criterion such that:

$$D(\mathbf{A}, \hat{\mathbf{A}}) = (\alpha_1, \alpha_2, \dots, \alpha_P)$$

where

$$15 \quad \alpha_p = \min_{1 \leq i \leq P} [d(\mathbf{a}_p, \hat{\mathbf{a}}_i)] \quad (17)$$

and where $d(\mathbf{u}, \mathbf{v})$ is the pseudo-distance between the vectors \mathbf{u} and \mathbf{v} , such that :

$$d(\mathbf{u}, \mathbf{v}) = 1 - \frac{|\mathbf{u}^H \mathbf{v}|^2}{(\mathbf{u}^H \mathbf{u})(\mathbf{v}^H \mathbf{v})} \quad (18)$$

20 8. A use of the method according to one of the claims 1 to 7 for a communications network.

9. A use of the method according to one of the claims 1 to 7 for goniometry using identified direction vectors.